US009442771B2

(12) United States Patent
Morgan

(10) Patent No.: US 9,442,771 B2
(45) Date of Patent: Sep. 13, 2016

(54) **GENERATING CONFIGURABLE SUBSCRIPTION PARAMETERS**

(75) Inventor: **Christopher Edwin Morgan**, Raleigh, NC (US)

(73) Assignee: **Red Hat, Inc.**, Raleigh, NC (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 859 days.

(21) Appl. No.: **12/954,378**

(22) Filed: **Nov. 24, 2010**

(65) **Prior Publication Data**

US 2012/0131594 A1 May 24, 2012

(51) **Int. Cl.**

G06F 15/173	(2006.01)
G06F 9/50	(2006.01)
G06Q 10/06	(2012.01)
G06F 3/06	(2006.01)

(52) **U.S. Cl.**

CPC ***G06F 9/5072*** (2013.01); *G06F 3/0647* (2013.01); *G06Q 10/06* (2013.01)

(58) **Field of Classification Search**

CPC G06F 9/46; G06F 3/0647; G06F 2209/50; G06Q 10/06

USPC 709/226

See application file for complete search history.

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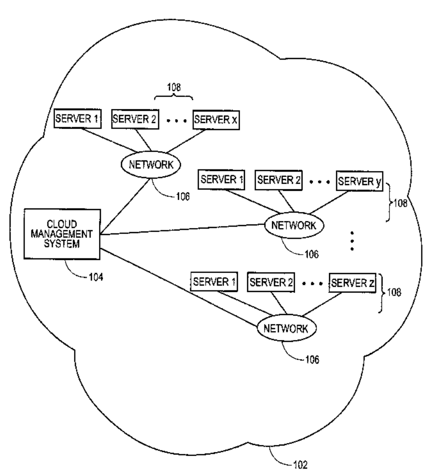
Primary Examiner — Joshua Joo
Assistant Examiner — Youndes Naji
(74) *Attorney, Agent, or Firm* — Lowenstein Sandler LLP

(57) **ABSTRACT**

Implementations relate to accessing a set of usage history data associated with a user account operating a workload on a set of virtual machines in a default deployment, generating, by a hardware processor, a predictive workload associated with the user account in view of the set of usage history data associated with the user account, responsive to generating the predictive workload, identifying a set of available resources in a set of host clouds of virtual machines provided by a cloud provider over the first period of time, accessing a set of deployment criteria received from the cloud provider, and generating a set of subscription parameters in view of the predictive workload, the set of available resources, and the set of deployment criteria to migrate the predictive workload to the set of host clouds of virtual machines.

21 Claims, 7 Drawing Sheets



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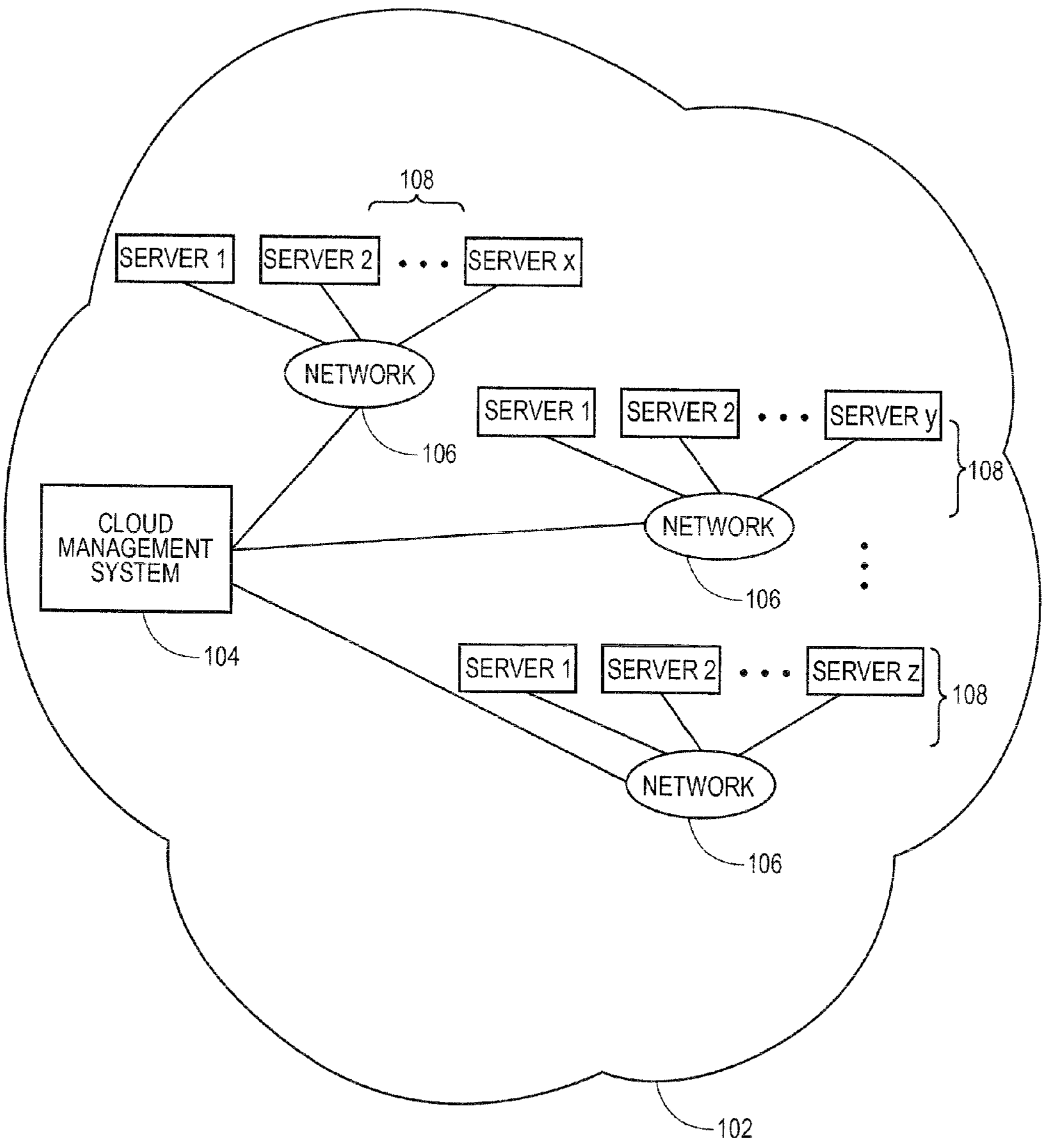
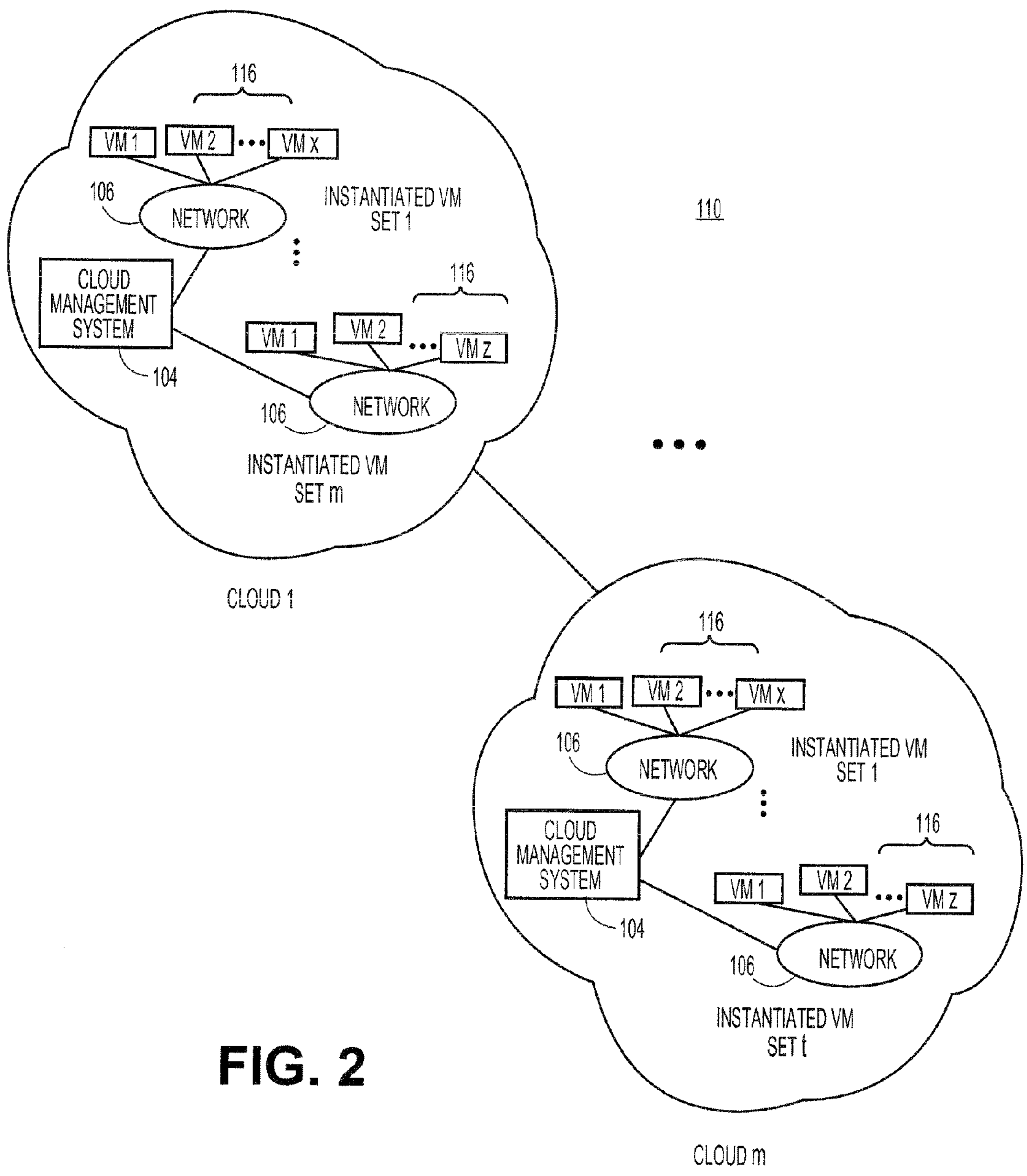

108
SERVER 1
SERVER 2
SERVER x
NETWORK
106
SERVER 1
SERVER 2
SERVER y
108
CLOUD MANAGEMENT SYSTEM
NETWORK
106
104
SERVER 1
SERVER 2
SERVER z
108
NETWORK
106
102

FIG. 1



116
VM 1
VM 2
VM x
106
NETWORK
INSTANTIATED VM SET 1
110
CLOUD MANAGEMENT SYSTEM
116
VM 1
VM 2
VM z
104
106
NETWORK
INSTANTIATED VM SET m
CLOUD 1
116
VM 1
VM 2
VM x
106
NETWORK
INSTANTIATED VM SET 1
CLOUD MANAGEMENT SYSTEM
116
VM 1
VM 2
VM z
104
106
NETWORK
INSTANTIATED VM SET t
CLOUD m

FIG. 2

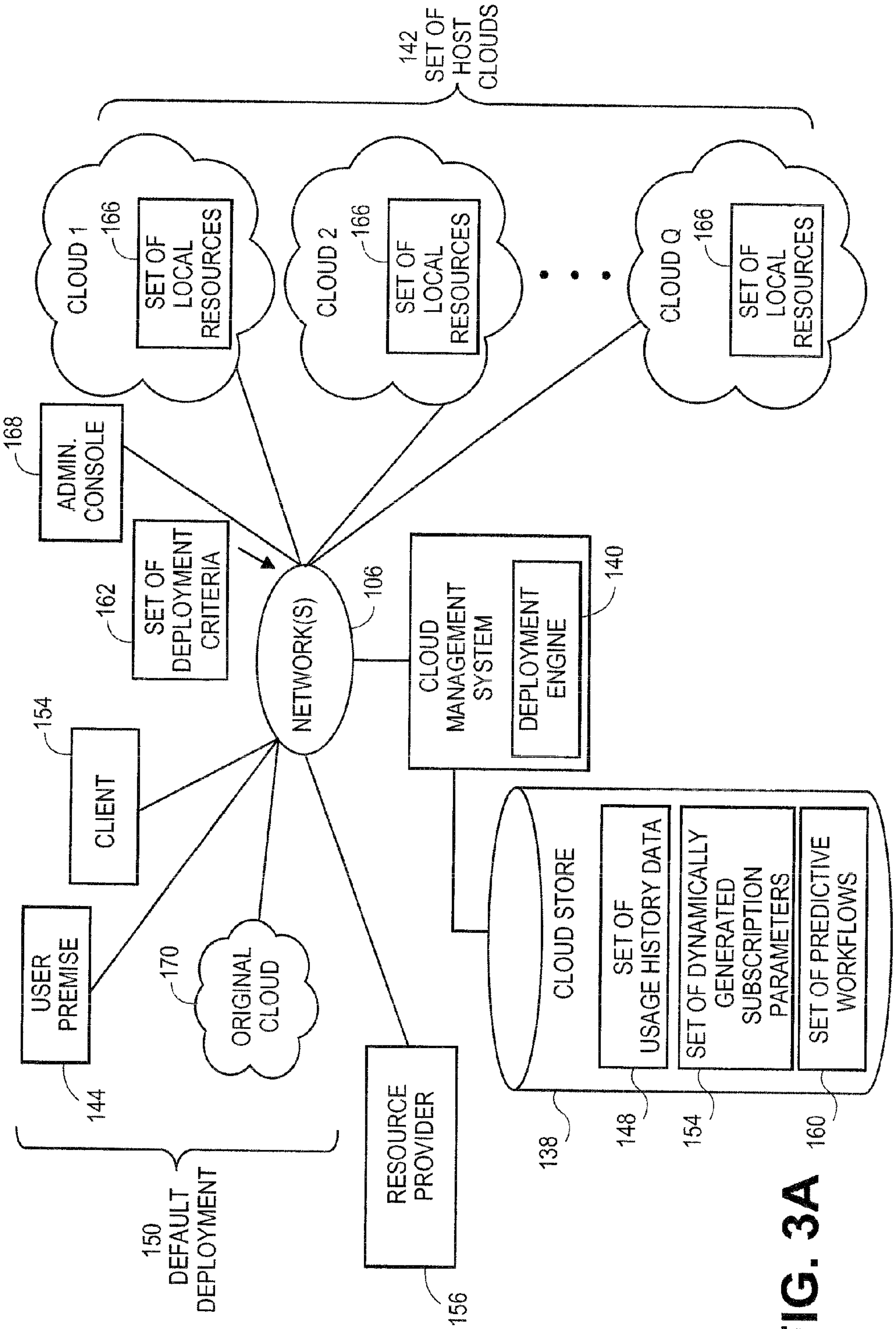

142 SET OF HOST CLOUDS
CLOUD 1
166
SET OF LOCAL RESOURCES
CLOUD 2
166
SET OF LOCAL RESOURCES
CLOUD Q
166
SET OF LOCAL RESOURCES
168
ADMIN. CONSOLE
162
SET OF DEPLOYMENT CRITERIA
NETWORK(S)
106
CLOUD MANAGEMENT SYSTEM
DEPLOYMENT ENGINE
140
154
CLIENT
USER PREMISE
144
170
ORIGINAL CLOUD
150 DEFAULT DEPLOYMENT
RESOURCE PROVIDER
156
CLOUD STORE
SET OF USAGE HISTORY DATA
SET OF DYNAMICALLY GENERATED SUBSCRIPTION PARAMETERS
SET OF PREDICTIVE WORKFLOWS
138
148
154
160

FIG. 3A

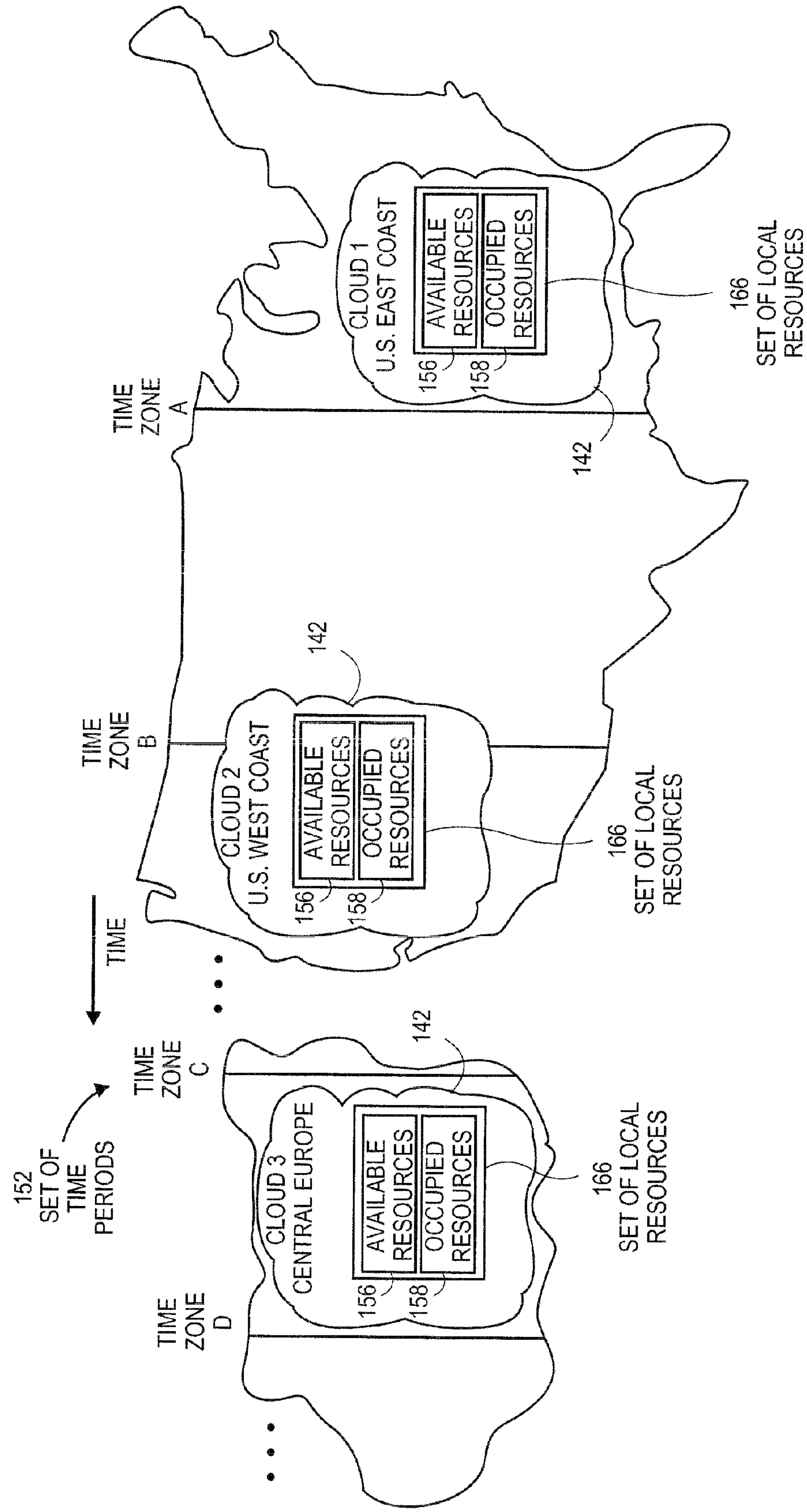

CLOUD 1
U.S. EAST COAST
AVAILABLE RESOURCES
OCCUPIED RESOURCES
156
158
166
SET OF LOCAL RESOURCES
142
TIME ZONE A
TIME ZONE B
CLOUD 2
U.S. WEST COAST
AVAILABLE RESOURCES
OCCUPIED RESOURCES
156
158
166
SET OF LOCAL RESOURCES
142
TIME
TIME ZONE C
TIME ZONE D
CLOUD 3
CENTRAL EUROPE
AVAILABLE RESOURCES
OCCUPIED RESOURCES
156
158
166
SET OF LOCAL RESOURCES
142
152
SET OF TIME PERIODS

FIG. 3B

HOST CLOUD C	LOCATION: AUSTRALIA	• • •	

HOST CLOUD B	LOCATION: CENTRAL EUROPE	DAILY PERIOD 1 12:00 AM - 8:00 AM EST	DAILY PERIOD 2 8:00 AM - 4:00 PM EST	DAILY PERIOD 3 12:00 AM - 4:00 PM EST
RESOURCE 1 - PROCESSOR		AVAILABLE: 15% OF 25000 MIPS	AVAILABLE: 30% OF 25000 MIPS	AVAILABLE: 8% OF 25000 MIPS
RESOURCE 2 - MEMORY		NOT AVAILABLE	AVAILABLE: 15% OF 600 GB	AVAILABLE: 90% OF 600 GB
RESOURCE 3 - STORAGE		AVAILABLE: 10% OF 1500 TB	AVAILABLE: 40% OF 1500 TB	AVAILABLE: 80% OF 1500 TB
⋮				
RESOURCE M		NOT AVAILABLE	AVAILABLE: M%	AVAILABLE: P%

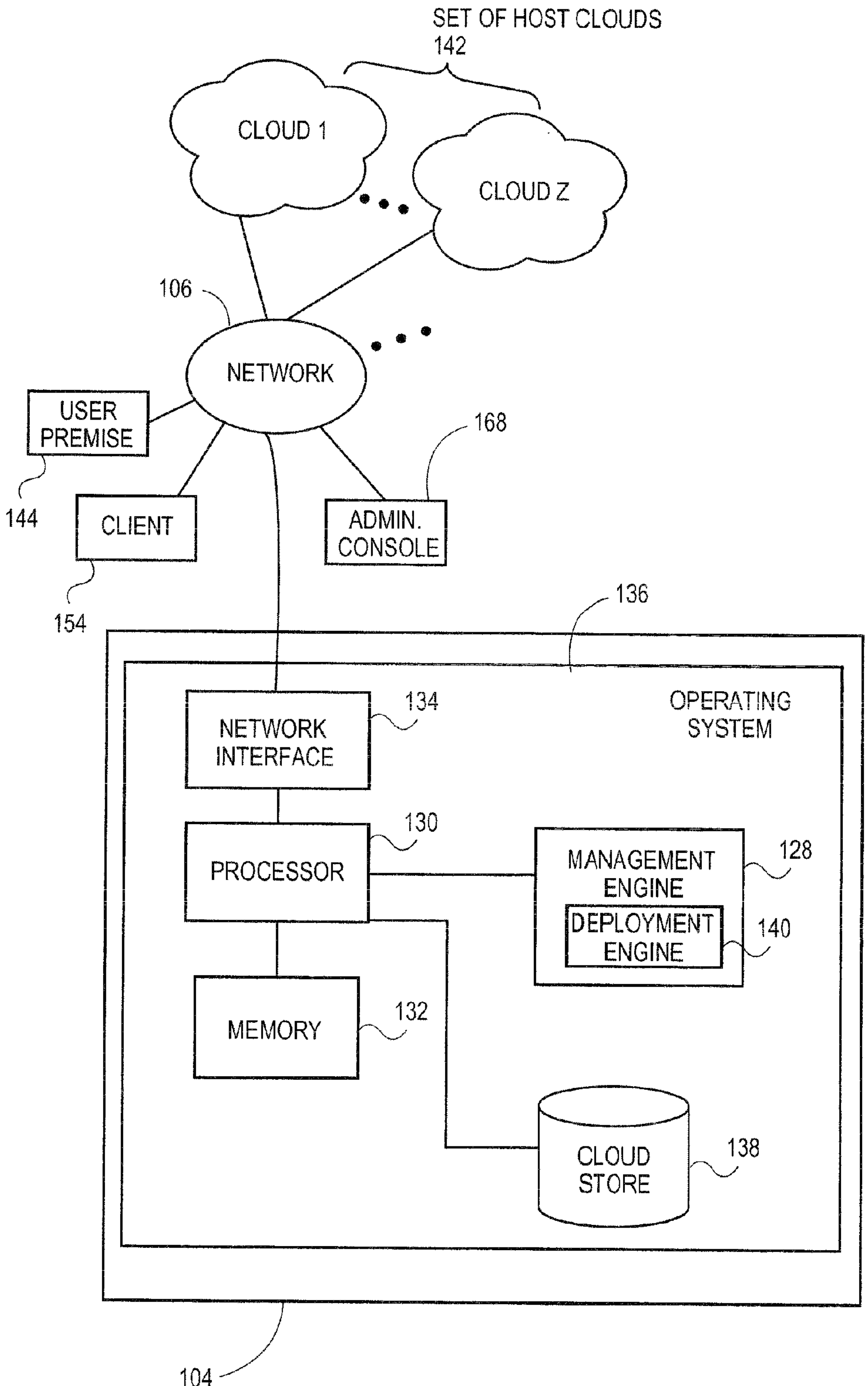
152 SET OF TIME PERIODS

HOST CLOUD A	LOCATION: U.S. WEST COAST	DAILY PERIOD 1 12:00 AM - 8:00 AM EST	DAILY PERIOD 2 8:00 AM - 4:00 PM EST	DAILY PERIOD 3 4:00 PM - 12:00 AM EST
RESOURCE 1 - PROCESSOR		AVAILABLE: 98% OF 10000 MIPS	AVAILABLE: 60% OF 10000 MIPS	AVAILABLE: 10% OF 10000 MIPS
RESOURCE 2 - MEMORY		AVAILABLE: 95% OF 400 GB	AVAILABLE: 70% OF 400 GB	NOT AVAILABLE
RESOURCE 3 - STORAGE		AVAILABLE: 80% OF 2000 TB	AVAILABLE: 50% OF 2000 TB	NOT AVAILABLE
⋮				
RESOURCE X		AVAILABLE: Z%	AVAILABLE: Y%	NOT AVAILABLE

152

172 HOST RESOURCE MATRIX

FIG. 4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142
CLOUD 1
CLOUD Z
106
NETWORK
USER PREMISE
144
CLIENT
154
ADMIN. CONSOLE
168
136
OPERATING SYSTEM
NETWORK INTERFACE
134
PROCESSOR
130
MANAGEMENT ENGINE
128
DEPLOYMENT ENGINE
140
MEMORY
132
CLOUD STORE
138
104

FIG. 5

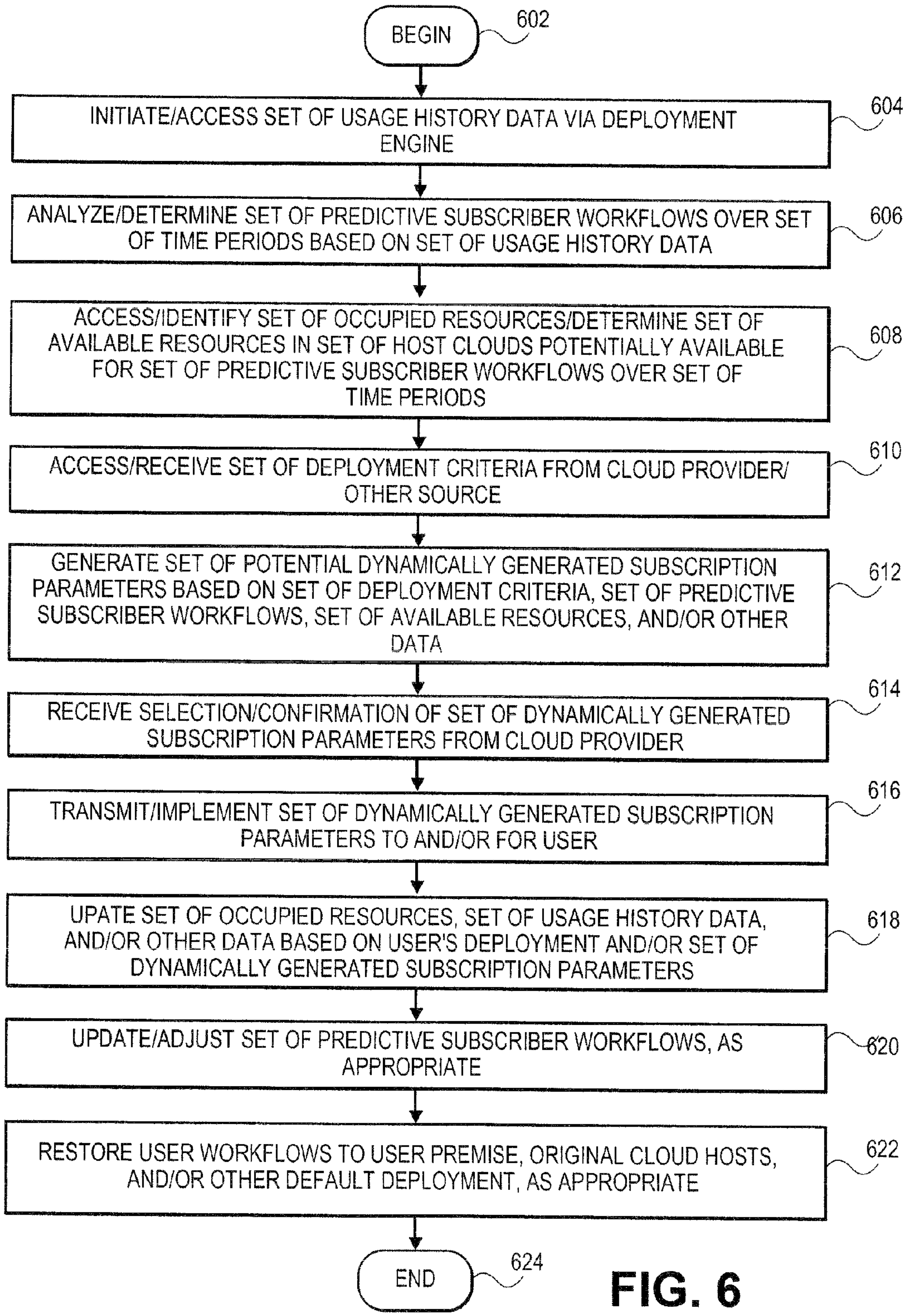
BEGIN
602
INITIATE/ACCESS SET OF USAGE HISTORY DATA VIA DEPLOYMENT ENGINE
604
ANALYZE/DETERMINE SET OF PREDICTIVE SUBSCRIBER WORKFLOWS OVER SET OF TIME PERIODS BASED ON SET OF USAGE HISTORY DATA
606
ACCESS/IDENTIFY SET OF OCCUPIED RESOURCES/DETERMINE SET OF AVAILABLE RESOURCES IN SET OF HOST CLOUDS POTENTIALLY AVAILABLE FOR SET OF PREDICTIVE SUBSCRIBER WORKFLOWS OVER SET OF TIME PERIODS
608
ACCESS/RECEIVE SET OF DEPLOYMENT CRITERIA FROM CLOUD PROVIDER/ OTHER SOURCE
610
GENERATE SET OF POTENTIAL DYNAMICALLY GENERATED SUBSCRIPTION PARAMETERS BASED ON SET OF DEPLOYMENT CRITERIA, SET OF PREDICTIVE SUBSCRIBER WORKFLOWS, SET OF AVAILABLE RESOURCES, AND/OR OTHER DATA
612
RECEIVE SELECTION/CONFIRMATION OF SET OF DYNAMICALLY GENERATED SUBSCRIPTION PARAMETERS FROM CLOUD PROVIDER
614
TRANSMIT/IMPLEMENT SET OF DYNAMICALLY GENERATED SUBSCRIPTION PARAMETERS TO AND/OR FOR USER
616
UPATE SET OF OCCUPIED RESOURCES, SET OF USAGE HISTORY DATA, AND/OR OTHER DATA BASED ON USER'S DEPLOYMENT AND/OR SET OF DYNAMICALLY GENERATED SUBSCRIPTION PARAMETERS
618
UPDATE/ADJUST SET OF PREDICTIVE SUBSCRIBER WORKFLOWS, AS APPROPRIATE
620
RESTORE USER WORKFLOWS TO USER PREMISE, ORIGINAL CLOUD HOSTS, AND/OR OTHER DEFAULT DEPLOYMENT, AS APPROPRIATE
622
END
624

FIG. 6

GENERATING CONFIGURABLE SUBSCRIPTION PARAMETERS

FIELD

The invention relates generally to systems and methods for generating dynamically configurable subscription parameters for the temporary migration of predictive user workloads in a cloud network, and more particularly, to platforms and techniques for tracking a cloud operator's available overnight or other off-peak resources, and permitting the operator to selectively configure subscription terms to offer to one or more users to allow the user's workloads to be shifted to those underutilized cloud networks on a temporary or other short-term basis.

BACKGROUND

The advent of cloud-based computing architectures has opened new possibilities for the rapid and scalable deployment of virtual Web stores, media outlets, social networking sites, and many other on-line sites or services. In general, a cloud-based architecture deploys a set of hosted resources such as processors, operating systems, software and other components that can be combined together to form virtual machines. A user or customer can request the instantiation of a virtual machine or set of machines from those resources from a central server or cloud management system to perform intended tasks, services, or applications. For example, a user may wish to set up and instantiate a virtual server from the cloud to create a storefront to market products or services on a temporary basis, for instance, to sell tickets to or merchandise for an upcoming sports or musical performance. The user can subscribe to the set of resources needed to build and run the set of instantiated virtual machines on a comparatively short-term basis, such as hours or days, for their intended application.

Typically, when a user utilizes a cloud, the user must track the software applications executed in the cloud and/or processes instantiated in the cloud. For example, the user must track the cloud processes to ensure that the correct cloud processes have been instantiated, that the cloud processes are functioning properly and/or efficiently, that the cloud is providing sufficient resources to the cloud processes, and so forth. Due in part to the user's requirements and overall usage of the cloud, the user may have many applications and/or processes instantiated in a cloud at any given instant, and the user's deployment of virtual machines, software, and other resources can change dynamically over time. In cases, the user may also utilize multiple independent host clouds to support the user's cloud deployment. That user may further instantiate and use multiple applications or other software or services inside or across multiple of those cloud boundaries, and those resources may be used or consumed by multiple or differing end-user groups in those different cloud networks.

In terms of the management of user workloads in a twenty-four hour cloud environment, some cloud providers who operate or have access to cloud-based networks hosted in diverse geographic regions may wish to provide their users with access to processing, memory, application, and/or other resources under advantageous terms during overnight or other off-peak time periods, on a temporary basis. That is, cloud providers who maintain cloud-based networks in a separate geographic areas, such as the East coast of the U.S. and West coast of the U.S., may experience different utilization rates of their hosted resources at different times of

day, due to business hours, daylight and evening hours, and/or other patterns or schedules. In periods of reduced cloud utilization, the cloud provider may discover that underutilized resources are available during overnight or other off-peak times, creating an opportunity to offer various temporary migration pathways to their users for their ongoing workloads.

In terms of potential re-hosting or re-seating of those workloads, existing cloud management platforms or other deployment tools do not afford a cloud operator to access and review their off-peak available resources, compare those available resources to the historical usage data of their corporate or other users or customers, and selectively configure subscription terms for possible temporary hosting of those workloads in geographically remote or dispersed clouds. In cases, the cloud provider may wish to place partial or full cloud support for a user's workload at a reduced off-peak or temporary subscription rate. In cases, the cloud provider may in addition or instead wish to offer different combinations of resources and/or service level agreements (SLAs) for various resources or services, such as to upgrade or downgrade processor, bandwidth, and/or other commitments to the user, at times that may be advantageous for the user, the cloud provider, or both.

It may accordingly be desirable to provide systems and methods for generating dynamically configurable subscription parameters for the temporary migration of predictive user workloads in a cloud network, in which a centralized deployment tool is configured to access the usage history for a subscriber or customer of a cloud provider, and assist in generating selective or dynamically generated subscription parameters to create temporary or short-term workload migrations to alternative host clouds based in dispersed or separated geographic areas and/or corresponding time zones.

DESCRIPTION OF DRAWINGS

FIG. **1** illustrates an overall cloud system architecture in which various aspects of systems and methods for generating dynamically configurable subscription parameters for the temporary migration of predictive user workloads in a cloud network can be practiced, according to embodiments;

FIG. **2** illustrates an overall cloud system architecture in which various aspects of systems and methods for generating dynamically configurable subscription parameters for the temporary migration of predictive user workloads in a cloud network can be practiced, in further regards;

FIGS. **3**A and **3**B illustrate various network configurations in which systems and methods for generating dynamically configurable subscription parameters for the temporary migration of predictive user workloads in a cloud network can be practiced, including the potential distribution of user workloads to geographically separated areas, according to various embodiments;

FIG. **4** illustrates an exemplary data structure in which the available off-peak resources of a set of geographically dispersed host clouds can be recorded, according to various aspects;

FIG. **5** illustrates an exemplary hardware configuration for a cloud management system that can support and maintain one or more cloud-based networks, according to various embodiments; and

FIG. **6** illustrates a flowchart for the analysis and processing of possible migrations of user workloads including potential temporary placements of those workloads to geographically remote or separated cloud networks, along with configuration options for those short-term subscriptions, in systems and methods for generating dynamically configurable subscription parameters for the temporary migration of predictive user workloads in a cloud network, according to various embodiments.

DESCRIPTION

Embodiments described herein can be implemented in or supported by a cloud network architecture. As used herein, a "cloud" can comprise a collection of hardware, software, services, and/or resources that can be invoked to instantiate a virtual machine, process, or other resource for a limited or defined duration. As shown for example in FIG. **1**, the collection of resources supporting a cloud **102** can at a hardware level comprise a set of resource servers **108** configured to deliver computing components needed to instantiate a virtual machine, process, service, or other resource. For example, one group of resource servers in set of resource servers **108** can host and serve an operating system, and/or components, utilities, or interfaces related to that operating system, to deliver to a virtual target, and instantiate that machine with an image of that operating system. Another group of servers in set of resource servers **108** can accept requests to host computing cycles or processor time, memory allocations, communications ports, bandwidth, pipes, or links, and/or other resources to supply a defined level of processing power or throughput for a virtual machine. A further group of resource servers in set of resource servers **108** can host and serve applications or other software to load on an instantiation of a virtual machine, such as an email client, a browser application, a messaging application, or other applications, software, or services. Other types of resource servers can be used to support one or more clouds **102**.

In embodiments, the entire set of resource servers **108** and/or other hardware or software resources used to support one or more clouds **102**, along with the set of instantiated virtual machines, can be managed by a cloud management system **104**. The cloud management system **104** can comprise a dedicated or centralized server and/or other software, hardware, services, and network tools that communicate via network **106**, such as the Internet or other public or private network, with all servers in set of resource servers **10**R to manage the cloud **102** and its operation. To instantiate a new or updated set of virtual machines, a user can transmit an instantiation request to the cloud management system **104** for the particular type of virtual machine they wish to invoke for their intended application. A user can for instance make a request to instantiate a set of virtual machines configured for email, messaging or other applications from the cloud **102**. The virtual machines can be instantiated as virtual client machines, virtual appliance machines consisting of special-purpose or dedicated-task machines as understood in the art, and/or as other virtual machines or entities. The request to invoke and instantiate the desired complement of virtual machines can be received and processed by the cloud management system **104**, which identifies the type of virtual machine, process, or other resource being requested in that platform's associated cloud. The cloud management system **104** can then identify the collection of hardware, software, service, and/or other resources necessary to instantiate that complement of virtual machines or other resources. In embodiments, the set of instantiated virtual machines or other resources can, for example, and as noted, comprise virtual transaction servers used to support Web storefronts, Web pages, and/or other transaction sites.

In embodiments, the user's instantiation request can specify a variety of parameters defining the operation of the set of virtual machines to be invoked. The instantiation request, for example, can specify a defined period of time for which the instantiated collection of machines, services, or processes is needed. The period of time can be, for example, an hour, a day, a month, or other interval of time. In embodiments, the user's instantiation request can specify the instantiation of a set of virtual machines or processes on a task basis, rather than for a predetermined amount or interval of time. For instance, a user could request a set of virtual provisioning servers and other resources until a target software update is completed on a population of corporate or other machines. The user's instantiation request can in further regards specify other parameters that define the configuration and operation of the set of virtual machines or other instantiated resources. For example, the request can specify a specific minimum or maximum amount of processing power or input/output (I/O) throughput that the user wishes to be available to each instance of the virtual machine or other resource. In embodiments, the requesting user can for instance specify a service level agreement (SLA) acceptable for their desired set of applications or services. Other parameters and settings can be used to instantiate and operate a set of virtual machines, software, and other resources in the host clouds. One skilled in the art will realize that the user's request can likewise include combinations of the foregoing exemplary parameters, and others. It may be noted that "user" herein can include a network-level user or subscriber to cloud-based networks, such as a corporation, government entity, educational institution, and/or other entity, including individual users and groups of users.

When the request to instantiate a set of virtual machines or other resources has been received and the necessary resources to build those machines or resources have been identified, the cloud management system **104** can communicate with one or more set of resource servers **108** to locate resources to supply the required components. Generally, the cloud management system **104** can select servers from the diverse set of resource servers **108** to assemble the various components needed to build the requested set of virtual machines, services, or other resources. It may be noted that in some embodiments, permanent storage, such as optical storage or hard disk arrays, may or may not be included or located within the set of resource servers **108** available to the cloud management system **104**, since the set of instantiated virtual machines or other resources may be intended to operate on a purely transient or temporary basis. In embodiments, other hardware, software or other resources not strictly located or hosted in one or more clouds **102** can be accessed and leveraged as needed. For example, other software or services that are provided outside of one or more clouds **102** acting as hosts, and are instead hosted by third parties outside the boundaries of those clouds, can be invoked by in-cloud virtual machines or users. For further example, other non-cloud hardware and/or storage services can be utilized as an extension to the one or more clouds **102** acting as hosts or native clouds, for instance, on an on-demand, subscribed, or event-triggered basis.

With the resource requirements identified for building a network of virtual machines, the cloud management system **104** can extract and build the set of virtual machines or other resources on a dynamic, on-demand basis. For example, one set of resource servers **108** may respond to an instantiation request for a given quantity of processor cycles with an offer to deliver that computational power immediately and guaranteed for the next hour or day. A further set of resource servers **108** can offer to immediately supply communication bandwidth, for example on a guaranteed minimum or best-efforts basis, for instance over a defined window of time. In other embodiments, the set of virtual machines or other resources can be built on a batch basis, or at a particular future time. For example, a set of resource servers **108** may respond to a request for instantiation of virtual machines at a programmed time with an offer to deliver the specified quantity of processor cycles within a specific amount of time, such as the next 12 hours. Other timing and resource configurations are possible.

After interrogating and receiving resource commitments from the set of resource servers **108**, the cloud management system **104** can select a group of servers in the set of resource servers **108** that match or best match the instantiation request for each component needed to build the user's requested virtual machine, service, or other resource. The cloud management system **104** for the one or more clouds **102** acting as the destination for the virtual machines can then coordinate the integration of the identified group of servers from the set of resource servers **108**, to build and launch the requested set of virtual machines or other resources. The cloud management system **104** can track the identified group of servers selected from the set of resource servers **108**, or other distributed resources that are dynamically or temporarily combined, to produce and manage the requested virtual machine population, services, or other cloud-based resources.

In embodiments, the cloud management system **104** can generate a resource aggregation table or other record that identifies the various selected sets of resource servers in set of resource servers **108** that will be used to supply the components of the set of instantiated virtual machines, services, or processes. The selected sets of resource servers can be identified by unique identifiers such as, for instance, Internet protocol (IP) addresses or other addresses. In aspects, different sets of servers in set of resource servers **108** can be selected to deliver different resources to different users and/or for different applications. The cloud management system **104** can register the finalized group of servers in the set resource servers **108** contributing to or otherwise supporting the set of instantiated machines, services, or processes.

The cloud management system **104** can then set up and launch the initiation process to instantiate the virtual machines, processes, services, and/or other resources to be hosted and delivered from the one or more clouds **102**. The cloud management system **104** can for instance transmit an instantiation command or instruction to the registered group of servers in the set of resource servers **108**. The cloud management system **104** can receive a confirmation message back from each registered server in set of resource servers **108** indicating a status or state regarding the provisioning of their respective resources. Various registered resource servers may confirm, for example, the availability of a dedicated amount of processor cycles, amounts of electronic memory, communications bandwidth, services, and/or applications or other software prepared to be served and delivered.

As shown for example in FIG. **2**, after coordination of the sources and configuration of resources including the hardware layer, selected software, and/or other resources, the cloud management system **104** can then instantiate a set of virtual machines **116**, and/or other appliances, services, processes, and/or entities, based on the resources supplied by servers within set of resource servers **108** registered to support the one or more clouds **102** in a multiple-cloud network **110**. According to aspects, cloud management system **104** can access or interact with a virtualization module, platform, or service to instantiate and operate set of virtual machines **116**, such as the kernel-based virtualization manager (KVM™) available from Red Hat, Inc. of Raleigh, N.C., or others. In embodiments, the cloud management system **104** can instantiate a given number, for example, 10, 500, 1000, 20,000, or other numbers or instances of virtual machines to populate one or more clouds **102** and be made available to users of that cloud or clouds. In aspects, users may access the one or more clouds **102** via the Internet, or other public or private networks. Each virtual machine can be assigned an instantiated machine ID that can be stored in the resource aggregation table, or other record or image of the instantiated virtual machine population. Additionally, the cloud management system **104** can store data related to the duration of the existence or operation of each operating virtual machine, as well as the collection of resources utilized by the overall set of instantiated virtual machines **116**.

In embodiments, the cloud management system **104** can further store, track and manage each user's identity and associated set of rights or entitlements to software, hardware, and other resources. Each user that operates a virtual machine or service in the set of virtual machines in the cloud can have specific rights and resources assigned and made available to them, with associated access rights and security provisions. The cloud management system **104** can track and configure specific actions that each user can perform, such as the ability to provision a set of virtual machines with software applications or other resources, configure a set of virtual machines to desired specifications, submit jobs to the set of virtual machines or other host, manage other users of the set of instantiated virtual machines **116** or other resources, and/or other privileges, entitlements, or actions. The cloud management system **104** associated with the virtual machine(s) of each user can further generate records of the usage of instantiated virtual machines to permit tracking, billing, and auditing of the resources and services consumed by the user or set of users. In aspects of the present teachings, the tracking of usage activity for one or more user (including network level user and/or end-user) can be abstracted from any one cloud to which that user is registered, and made available from an external or independent usage tracking service capable of tracking software and other usage across an arbitrary collection of clouds, as described herein. In embodiments, the cloud management system **104** of an associated cloud can for example meter the usage and/or duration of the set of instantiated virtual machines **116**, to generate subscription and/or billing records for a user that has launched those machines. In aspects, tracking records can in addition or instead be generated by an internal service operating within a given cloud. Other subscription, billing, entitlement and/or value arrangements are possible.

The cloud management system **104** can configure each virtual machine in set of instantiated virtual machines **116** to be made available to users via one or more networks **116**, such as the Internet or other public or private networks. Those users can for instance access set of instantiated virtual machines via a browser interface, via an application server such as a Java™ server, via an application programming interface (API), and/or other interface or mechanism. Each instantiated virtual machine in set of instantiated virtual machines **116** can likewise communicate with its associated cloud management system **104** and the registered servers in set of resource servers **108** via a standard Web application programming interface (API), or via other calls, protocols, and/or interfaces. The set of instantiated virtual machines **116** can likewise communicate with each other, as well as other sites, servers, locations, and resources available via the Internet or other public or private networks, whether within a given cloud in one or more clouds **102**, or between those or other clouds.

It may be noted that while a browser interface or other front-end can be used to view and operate the set of instantiated virtual machines **116** from a client or terminal, the processing, memory, communications, storage, and other hardware as well as software resources required to be combined to build the virtual machines or other resources are all hosted remotely in the one or more clouds **102**. In embodiments, the set of virtual machines **116** or other services, machines, or resources may not depend in any degree on or require the user's own on-premise hardware or other resources. In embodiments, a user can therefore request and instantiate a set of virtual machines or other resources on a purely off-premise basis, for instance to build and launch a virtual storefront, messaging site, and/or any other application. Likewise, one or more clouds **102** can also be formed in whole or part from resources hosted or maintained by the users of those clouds, themselves.

Because the cloud management system **104** in one regard specifies, builds, operates and manages the set of instantiated virtual machines **116** on a logical or virtual level, the user can request and receive different sets of virtual machines and other resources on a real-time or near real-time basis, without a need to specify, install, or configure any particular hardware. The user's set of instantiated virtual machines **116**, processes, services, and/or other resources can in one regard therefore be scaled up or down immediately or virtually immediately on an on-demand basis, if desired. In embodiments, the set of resource servers **108** that are accessed by the cloud management system **104** to support the set of instantiated virtual machines **116** or processes can change or be substituted, over time. The type and operating characteristics of the set of instantiated virtual machines **116** can nevertheless remain constant or virtually constant, since instances are assembled from a collection of abstracted resources that can be selected and maintained from diverse sources based on uniform specifications. Conversely, the users of the set of instantiated virtual machines **116** can also change or update the resource or operational specifications of those machines at any time. The cloud management system **104** and/or other logic can then adapt the allocated resources for that population of virtual machines or other entities, on a dynamic basis.

In terms of network management of the set of instantiate virtual machines **116** that have been successfully configured and instantiated, the one or more cloud management systems **104** associated with those machines can perform various network management tasks including security, maintenance, and metering for billing or subscription purposes. The cloud management system **104** of one or more clouds **102** can, for example, install, initiate, suspend, or terminate instances of applications or appliances on individual machines. The cloud management system **104** can similarly monitor one or more operating virtual machines to detect any virus or other rogue process on individual machines, and for instance terminate an application identified as infected, or a virtual machine detected to have entered a fault state. The cloud management system **104** can likewise manage the set of instantiated virtual machines **116** or other resources on a network-wide or other collective basis, for instance, to push the delivery a software upgrade to all active virtual machines or subsets of machines. Other network management processes can be carried out by cloud management system **104** and/or other associated logic.

In embodiments, more than one set of virtual machines can be instantiated in a given cloud at the same time, at overlapping times, and/or at successive times or intervals. The cloud management system **104** can, in such implementations, build, launch and manage multiple sets of virtual machines as part of the set of instantiated virtual machines **116** based on the same or different underlying set of resource servers **108**, with populations of different virtual machines such as may be requested by the same or different users. The cloud management system **104** can institute and enforce security protocols in one or more clouds **102** hosting one or more sets of virtual machines. Each of the individual sets or subsets of virtual machines in the set of instantiated virtual machines **116** can be hosted in a respective partition or sub-cloud of the resources of the main cloud **102**. The cloud management system **104** of one or more clouds **102** can for example deploy services specific to isolated or defined sub-clouds, or isolate individual workloads/processes within the cloud to a specific sub-cloud or other sub-domain or partition of the one or more clouds **102** acting as host. The subdivision of one or more clouds **102** into distinct transient sub-clouds, sub-components, or other subsets which have assured security and isolation features can assist in establishing a multiple user or multi-tenant cloud arrangement. In a multiple-user scenario, each of the multiple users can use the cloud platform as a common utility while retaining the assurance that their information is secure from other users of the same one or more clouds **102**. In further embodiments, sub-clouds can nevertheless be configured to share resources, if desired.

In embodiments, and as also shown in FIG. **2**, the set of instantiated virtual machines **116** generated in a first cloud in one or more clouds **102** can also interact with a set of instantiated virtual machines, services, and/or processes generated in a second, third or further cloud in one or more clouds **102**, comprising a multiple-cloud network **110**. The cloud management system **104** of a first cloud of one or more clouds **102** can interface with the cloud management system **104** of a second, third, or further cloud of one or more clouds **102** to coordinate those domains and operate the clouds and/or virtual machines, services, and/or processes on a combined basis. The cloud management system **104** of a given cloud on one or more clouds **102** can in aspects track and manage individual virtual machines or other resources instantiated in that cloud, as well as the set of instantiated virtual machines or other resources in other clouds.

In the foregoing and other embodiments, the user making an instantiation request or otherwise accessing or utilizing the cloud network can be a person, customer, subscriber, administrator, corporation, organization, government, and/or other entity. In embodiments, the user can be or include another virtual machine, application, service and/or process. In further embodiments, multiple users or entities can share the use of a set of virtual machines or other resources.

Aspects of the present teachings relate to platforms and techniques in which a centralized or distributed deployment engine and/or other logic can track and manage the migration of user workloads to underutilized clouds in different geographic zones, and/or to host clouds which are underutilized or available for other reasons. FIG. **3**A shows an illustrative network configuration in which systems and methods for generating dynamically configurable subscription parameters for the temporary migration of predictive user workloads in a cloud network can be implemented, according to various embodiments. In embodiments as shown, the operator or provider of a set of host clouds **142** can track, deploy, and manage user workloads that are subscribed to the set of host clouds **142**, including a set of local resources **166** such as processor, memory, storage, communications, operating system, application, and/or other resources based, located, and/or hosted in the respective clouds of the set of host clouds **142**. It may be noted that in various aspects, a workload can consist of a set of executed or executing processing, computation, storage, communication, and/or other other tasks carried out under control of a programmed, automatic, and/or other work flow or flows. In aspects as shown, the operator or provider of the set of host clouds **142** can access an administrative console **168**, such as a desktop computer or workstation, to monitor and manage the set of host clouds **142** and user deployments to the set of host clouds **142**. In aspects, the provider or operator of the set of host clouds **142** can use the administrative console **168** and/or other access sites, ports, and/or services to access and/or initiate a deployment engine **140** hosted in cloud management system **104** for the set of host clouds **142** to initiate and manage the scheduling and configuration of off-peak and/or other temporary or short-term deployments of a user's workloads to the set of host clouds **142**.

In aspects as shown, the subject user or users can operate a default deployment **150**, illustrative shown as comprising a user premise, such as a corporate or other local area network (LAN) including servers, clients, and storage resources, as well as at least one original cloud **170**, which can comprise a cloud-based network in which a user maintains a comparatively long-term subscription, such as for virtual machine, software and/or other resources. The default deployment **150** for the user can comprise other types, combinations, and/or configurations of hardware-based and/or cloud-based networks and resources. In aspects, the user(s) can access and/or manage the default deployment **150** via a client **154**, and/or other channel, machine, site, and/or service. In aspects and as also shown in FIG. **3**A, one or more resource providers **156** can communicate or interact with the default deployment **150**, client **154**, administrative console **168**, set of host clouds, and/or other locations or resources. The one or more resource providers **156** can include independent software vendors (ISVs), such as operator system and/or application vendors who offer various software entitlements for subscription to users, for instance on a periodic, on-demand, and/or other basis.

In aspects, the deployment engine **140** can access, update, store and track a set of usage history data **148** that reflects the consumption by the user of their subscribed resources in the default deployment of the user, and/or of the set of local resources **166** which the user may temporarily consume when operating workloads in the set of host clouds **142** on an off-peak or temporary basis, as described herein. In aspects, the set of usage history data **148** can reflect daily, weekly, monthly, and/or other recurring patterns in the user's consumption of resources, for instance based on business or commercial patterns or schedules that affect the user's demands for computing resources. Thus for instance, a retail user may have a set of usage history data **148** which reflects a high degree of consumption of processor and communications bandwidth during retail hours, such as 10:00 a.m. to 9:00 p.m., reflecting the operation of a large number of point of sale (POS) terminals while retail outlets are open and transacting business. The set of usage history data **148** for the same user may reflect a lower amount of processor and communications bandwidth consumption after close of scheduled retail hours, followed by an increase in database and/or storage consumption from for instance 12:00 a.m. to 6:00 a.m. as the enterprise applications of that user perform inventory and other adjustments for the following business day. Other increases, decreases, adjustments, and/or other patterns for the consumption of resources can be reflected in the set of usage history data **148**. In aspects, the set of usage history data **148** maintained by one provider or operator of the set of host clouds **142** and/or other networks can incorporate resource consumption and workloads from more than one user.

According to regards, the deployment engine **140** and/or other logic can analyze the set of usage history data **148** to develop or generate a set of predictive workloads **160** for a subject user. The set of predictive workloads **160** can reflect an expected set of consumption rates for one or more periods or intervals of time for that user, based on the historical trend or patterns demonstrated in the set of usage history data **148** for those resources. The set of predictive workloads **160** can in regards be generated by taking the average consumption rates for one or more resources over daily, weekly, and/or other intervals, so that, for instance, a retail user as noted may be assigned a set of predictive workloads **160** including a minimum of 30,000 MIPs (millions of instructions per second) per hour of processing throughput for the period of 10:00 a.m. to 9:00 p.m., along with a minimum of 2,000 instances of an operating system, followed by a minimum storage requirement of 300 Terabytes (TB) from 12:00 a.m. to 6:00 a.m. along with 400 instances of a database application. Other time periods, resources, and/or consumption rates can be generated or identified in the set of predictive workloads **160**. After generation of the set of predictive workloads **160**, the deployment engine **140** can examine the set of local resources **166** available in the set of host clouds **142** over the same time periods, to determine whether any one or more host cloud in the set of host clouds **142** can host or absorb the user's workloads, on an overnight and/or other temporary or short-term basis. In aspects, the provider or operator of the set of host clouds **142** can input or specify and set of deployment criteria **162** indicating or filtering those resources in the set of local resources **166** they may wish to offer or provide to the subject user, in the form of a set of dynamically generated subscription parameters **154** under which the user can temporarily deploy or migrate their workloads to the set of host clouds **142**.

More particularly, and as for instance shown in FIG. **3**B, the set of host clouds **142** can in instances be based, located, and/or hosted in a collection of geographically separate or dispersed areas, such as the U.S. East coast, the U.S. West coast, a central Europe site, and/or other locations or areas. In aspects, different cloud-based networks in the set of host clouds **142** can for instance be located in different time zones, such as different or diverse time zones established in the universal coordinated time (UCT) and/or other time-keeping systems. Each geographically dispersed cloud in the set of host clouds **142** can have a different set of local resources **166** which can, for each cloud, comprise a set of available resources **156** and a set of occupied resources **158**, reflecting local processor, memory, software, and/or other resources that may be available for subscription and use, or not available for subscription or use due for example to use by other users, maintenance operations, and so forth. In aspects, the deployment engine **140** can examine the set of available resources **156** for the individual clouds in the set of host clouds **142**, determine those clouds having set of available resources **156** matching or satisfying the set of predictive workloads **160** for a user, and identify that cloud or clouds as a potential short-term or temporary for the set of predictive workloads **160** over the corresponding overnight or other set of time periods **152**. With the candidate host clouds identified, the deployment engine **140** can apply the set of deployment criteria **162** which the provider or operator of the set of host clouds **142** wishes to apply, such as, for instance, "identify those host clouds that permit a subscription to a minimum processor throughput of 40,000 MIPs for at least 30% less than the user's subscription rates in their default deployment." Other criteria can be used. The deployment engine **140** can apply the set of deployment criteria **162** to generate the set of dynamically generated subscription parameters **154** to present or deliver to the user, for possible overnight and/or other time-varying or temporary use. In aspects, the user can configure their subscription with the provider or operator of the set of host clouds **142**, and/or with the one or more resource providers **156**, to automatically accept the set of dynamically generated subscription parameters **154** for off-peak or other deployment of their workloads. In aspects, the deployment engine **140** can notify the user and wait for user selection or confirmation of acceptance of the set of dynamically generated subscription parameters **154**, before moving the user's workloads to the set of host clouds **142** under terms or conditions identified in the set of dynamically generated subscription parameters **154**. It may be noted that in regards, the set of dynamically generated subscription parameters **154** can reflect dynamic or time-varying terms, conditions, or criteria, including subscription costs and service level agreements (SLAs), based on changing conditions in the set of host clouds **142**, the default deployment **150**, and/or other operating conditions or related data. In aspects, the provider or operator of the set of host clouds **142**, the one or more resource providers **156**, and/or other entities can specify default criteria in the set of deployment criteria **162** to automatically generate the lowest possible subscription costs to the user for temporarily migrating their set of predictive workloads **160**, but can also or instead, as noted, specify minimum or maximum resource commitment levels, different resource availability in the set of time periods **152**, and/or other criteria, filters, thresholds, constraints, or conditions. In aspects, the set of dynamically generated subscription parameters **154** can accordingly be updated on a regular, irregular, even-triggered and/or other basis, such as every hour, day, week, month, and/or other period. In further aspects, the set of dynamically generated subscription parameters **154** can accordingly specify or offer different subscription costs and/or other conditions for different days of the week, and/or differing or varying in other intervals of the set of time periods **152**, depending on changing conditions in the set of host clouds **142** and/or other factors.

In terms of the capture and management of the set of usage history data **148**, and the correlation and analysis of the set of local resources **166** hosted in the set of host clouds **142** to potentially host the workloads of a user reflected in the set of usage history data **148**, FIG. **4** illustrates data structures and/or encoding that can be used to record the resources available to the cloud provider of set of host clouds **142** to offer or deploy for a subject end-user over different periods of time. In aspects as shown, the deployment engine **140** and/or other logic can capture and store a time-varying host resource matrix **172**, in which the set of available resources **156** and the set of occupied resources **158** of the set of host clouds **142** can be reflected for set of time periods **152**. In aspects, the set of time periods **152** can comprise a division of the hours of a day into different intervals. In aspects, the different intervals of set of time periods **152** can correspond to different periods in a business day, and/or can reflect different patterns or schedules. In aspects, and as merely illustratively shown, the set of time periods **152** can reflect a division of the times of day into three periods, such as midnight to 8:00 a.m., 8:00 a.m. to 4:00 p.m., and 4:00 p.m. to midnight. Other times, intervals, and/or periods can be used, as well as different numbers of periods. In aspects, the set of time periods **152** can be divided into equal intervals or periods, unequal intervals or periods, and/or combinations of both.

According to aspects, the time-varying host resource matrix **172** can reflect the set of occupied resources **158** of one or more host clouds in the set of host clouds **142** over different intervals or periods in the set of time periods **152**. In aspects, resources (such as processor, memory, operating system instances, and/or others) can be recorded as occupied or unavailable due to various events or conditions, such as the reservation of those resources for other users or entities subscribing to them in the applicable time period, the removal of those resources for maintenance or upgrade purposes, and/or other reasons. The set of local resources **166** in the set of host clouds **142** which are unreserved or unused can be recorded in the host resource matrix **172** as part of the set of available resources **156**, and therefore available to be offered to the customer(s) or other user(s) of the set of host clouds **142** from the cloud operator of the set of host clouds **142**. In aspects, the host resource matrix **172** can be updated on an hourly, daily, and/or other basis or schedule to reflect newly available and/or newly unavailable resources in the set of local resources **166** from which the operator of the set of host clouds **142** wishes to offer to host the set of predictive workloads **160** for the subject user or other entity. In aspects as described herein, the deployment engine **140** and/or other logic can analyze the host resource matrix **172** using the set of deployment criteria, the set of usage history data **148**, and/or other data, filters, and/or logic to generate the set of dynamically generated subscription parameters **152** to permit migration or deployment of the set of predictive workloads **160** and/or other user workloads or consumption requirements to the set of host clouds **142**, on a geographically staggered and/or otherwise managed basis.

FIG. **5** illustrates an exemplary diagram of hardware and other resources that can be incorporated in a cloud management system **104** configured to communicate with the set of instantiated virtual machines **116**, deployment engine **140**, set of host clouds **142**, set of predictive workloads **160**, and/or other entities, services, data, or resources via one or more networks **106** and/or other connections, according to embodiments. In embodiments as shown, the cloud management system **104** can comprise a processor **130** communicating with memory **132**, such as electronic random access memory, operating under control of or in conjunction with an operating system **136**. The operating system **136** can be, for example, a distribution of the Linux™ operating system, the Unix™ operating system, or other open-source or proprietary operating system or platform. The processor **130** also communicates with a cloud store **138**, such as a database stored on a local hard drive, and a management engine **128**, to execute control logic and control the operation of virtual machines and other resources in one or more clouds **102**, the set of target clouds **142**, and/or other collections of clouds. The processor **130** further communicates with a network interface **134**, such as an Ethernet or wireless data connection, which in turn communicates with the one or more networks **106**, such as the Internet or other public or private networks. The processor **130** and/or the cloud management system **104** can likewise communicate with the deployment engine **140**, the set of usage history data **148**, the user premise **144**, the client **154**, the set of host clouds **142**, the administrative console **168**, the set of predictive workloads **160**, and/or other interfaces, applications, sites, services, data, and/or logic. Other configurations of the cloud management system **104**, associated network connections, and other hardware, software, and service resources are possible. It may be noted that in embodiments, the client **154**, the administrative console **168**, and/or other hardware machines, platforms, or engines can comprise the same or similar resources as cloud management system **104**, or can be configured with different hardware and software resources.

FIG. **6** illustrates a flowchart of overall processing to perform workload analysis and identify off-peak and/or other temporary deployments for a user under advantageous and/or modified terms, according to various embodiments of the present teachings. In **602**, processing can begin. In **604**, an administrator and/or other user can initiate and/or access a set of usage history data via deployment engine **140**. In aspects, the user can be an administrator of the provider set of host clouds **142**, of one or more resource providers **156**, of the user whose set of usage history data **148** is being analyzed, and/or other users or entities. In **606**, the deployment engine **140** can analyze and/or identify a set of predictive workloads **160** based on the subject user or subscriber's set of usage history data **148** and/or other information. For instance, the deployment engine **140** can determine that if the user, such as a bank and/or other commercial entity, tends to demonstrate the consumption of a relatively high amount of communications bandwidth while operating a set of financial software applications from 8:00 a.m. to 4:00 pm U.S. Eastern time, with relatively low processor and application consumption from 4:00 pm to 10:00 p.m. Eastern time, followed by increased processor and storage consumption from 10:00 p.m. to 2:00 a.m. as a relatively large number of account files or data are processed and reconciled for the next business day. In such illustrative cases, the deployment engine **140** may predict or project heavy processor, memory, and storage consumption for the 10:00 p.m. to 2:00 a.m. period, and/or other intervals or periods in the set of time periods **152** and/or other subscription periods or intervals for that user, with lesser demands for resources over other intervals or periods. In aspects, the set of predictive workloads **160** can be generated and/or identified by taking averages or medians of time periods, resource consumption data, and/or other information contained in the set of usage history data **148**. In embodiments, other calculations, computations, and/or decision logic can be used to generate the set of predictive workloads **160**.

In **608**, the deployment engine **140** and/or other logic can access and/or identify the set of occupied resources **158**, and determine a set of available resources **156** located in the set of host clouds **142** for the desired or relevant time periods that correspond to the set of predictive workloads **160** for the subject user. Thus, in aspects the deployment engine **140** and/or other logic can determine or identify those clouds in the set of host clouds **142** which have enough available processing throughput to service the aforementioned illustrative bank user who wishes to perform account reconciliation operations from 10:00 p.m. to 2:00 a.m. each evening, each weekday evening, or at other times or intervals. Resource matching and/or other analysis can be performed for other resources and/or combinations of resources. In **610**, the deployment engine **140** and/or other logic can access and/or receive the set of deployment criteria **162** from the provider or operator of the set of host clouds **142**, and/or from other sources. In aspects, the set of deployment criteria **162** can comprise a selection, input, and/or other identification of the subscription criteria and/or other filters or factors which the provider of the set of host clouds **142** and/or other user wishes to be satisfied, weighted, maximized, optimized, and/or selected for packaging or presentation to the subject user. For instance, the set of deployment criteria **162** can be or include a specification of cost or cost variables for overnight and/or other temporary deployment to the set of host clouds **142** during a defined set of time periods **152**. For instance, the provider of the set of host clouds **142** and/or other entity can specify that they wish to analyze potential costs schedules which will afford the subject user at least a net 15% cost reduction for shifting their workloads and corresponding consumption of cloud resources to the of host clouds **142** on an overnight or other basis. In aspects, the set of deployment criteria **162** can specify other parameters or criteria in addition to and/or instead of subscription or other cost factors, such as for example to specify that they wish to analyze potential cost schedules which will afford the subject user at least a 10% reduction for shifting their workloads to the set of host clouds **142** on an overnight or other basis, while maintaining a service level agreement (SLA) of at least 75% of the service level agreement (SLA) (e.g., for processor, memory, storage, operating system, and/or application instances) provided by the user's default deployment **150**. Other criteria or parameters can be used.

In **612**, the deployment engine **140** and/or other logic can generate a set of dynamically generated subscription parameters **154** based on the set of deployment criteria **162**, the set of predictive workloads **160**, the set of available resources **156**, and/or other data. In **614**, the deployment engine **140** and/or other logic can receive a selection and/or confirmation of one or more of the set of dynamically generated subscription parameters **154** from the provider of the set of host clouds **142**, indicating that provider wishes to select, offer, and/or implement those potential subscription terms to the subject user. In **616**, the deployment engine **140** and/or other logic or entity, such as the cloud management system **104** and/or the provider of the set of host clouds **142**, can transmit the set of dynamically generated subscription parameters **154** to and/or for the subject user to initiate deployment of the user's default deployment **150** and/or related workloads or portions thereof to the set of host clouds **142**. In aspects, the deployment can be for one or more defined period in the set of time periods **152**, such as from a first period from 6:00 p.m. to 12:00 midnight, a second period from 12:00 midnight to 6:00 a.m., and/or other periods, times, or intervals. In **618**, the deployment engine **140** and/or other logic can update the sat of occupied resources **158**, the set of usage history data **148**, and/or other data based on the user's deployment of their workloads to the set of host clouds **142**, on the selected or configured overnight, temporary, and/or other basis.

In **620**, the deployment engine **140** and/or other logic can update the set of predictive workloads **160**, as appropriate. For instance, the deployment engine **140** and/or other logic can update the set of predictive workloads **160** based on updates to the set of usage history data **148**, updates to the user's default deployment, updates from the results of deployment to the set of host clouds **142** on an overnight, temporary, and/or other basis, and/or based on other data or based on other events. In **622**, the deployment engine **140** and/or other logic can restore the user's workloads to the user premise **144**, the original cloud hosts of that user's workloads, and/or other networks, components or resources of the default deployment **150**, as appropriate. In **624**, as understood by persons skilled in the art, processing can repeat, return to a prior processing point, jump to a further processing point, or end.

The foregoing description is illustrative, and variations in configuration and implementation may occur to persons skilled in the art. For example, while embodiments have been described in which the cloud management system **104** for a particular cloud resides in a single server or platform, in embodiments the cloud management system **104** and associated logic can be distributed among multiple servers, services, or systems. Similarly, while embodiments have been described in which one group of servers within a set of resource servers **108** can provide one component to build a requested set of virtual machines, in embodiments, one group of resource servers can deliver multiple components to populate the requested set of instantiated virtual machines **116**, and/or other machines, entities, services, or resources. For further example, while embodiments have been described in which user workloads can be temporarily deployed to one set of host clouds **142**, in aspects, the deployment engine **140** and related resources can track and make available multiple sets of host clouds, for instance in staggered and/or overlapping geographic areas, to the user for their off-peak or other workloads. Other resources described as singular or integrated can in embodiments be plural or distributed, and resources described as multiple or distributed can in embodiments be combined. The scope of the invention is accordingly intended to be limited only by the following claims.

The invention claimed is:

1. A method comprising:

accessing a set of usage history data associated with a user account operating a workload on a set of virtual machines in a default deployment;

generating, by a hardware processor, a predictive workload associated with the user account in view of the set of usage history data associated with the user account, wherein the predictive workload reflects an average of a set of resource consumption rates over a first period of time, the set of resource consumption rates determined from the set of usage history data associated with the user account over a set of resources;

responsive to generating the predictive workload, identifying a set of available resources in a set of host clouds of virtual machines provided by a cloud provider over the first period of time;

accessing a set of deployment criteria received from the cloud provider; and

generating a set of subscription parameters in view of the predictive workload, the set of available resources, and the set of deployment criteria to migrate the predictive workload to the set of host clouds of virtual machines.

2. The method of claim **1**, further comprising:

dynamically generating the set of subscription parameters,

wherein the set of host clouds comprises a set of geographically dispersed host clouds.

3. The method of claim **2**, wherein the set of geographically dispersed host clouds comprises at least one host cloud operating in a first coordinated universal time (UTC) time zone and a second host cloud operating in a second coordinated universal time (UTC) time zone.

4. The method of claim **3**, wherein the predictive workload is predicted for the user account in the second universal coordinated time (UTC) time zone for a time period for the user account.

5. The method of claim **4**, wherein the time period for the user account is determined by analyzing the set of usage history data of the user account.

6. The method of claim **5**, wherein the set of deployment criteria comprises a least-cost criteria for the user account in view of migration of the predictive workload to the set of host clouds during the time period for the user account.

7. The method of claim **6**, wherein the set of subscription parameters comprises a reduced subscription cost in view of execution of the predictive workload in the set of host clouds during the time period for the user account.

8. The method of claim **7**, wherein the set of subscription parameters comprises a service level agreement (SLA) to be maintained for host cloud resources in the set of host clouds during the time period for the user account.

9. The method of claim **8**, further comprising migrating the workload from the default deployment to the set of host clouds during the time period for the user account in view of the set of subscription parameters.

10. The method of claim **9**, further comprising migrating the workload from the set of host clouds to the default deployment after the time period for the user account.

11. The method of claim **4**, wherein the time period for the user account comprises a plurality of different predetermined time periods for the user account.

12. The method of claim **1**, wherein the set of usage history data comprises at least one of processor usage data, memory usage data, storage usage data, communications bandwidth usage data, operating system usage data, application usage data, service usage data, virtual machine instance data, or appliance usage data.

13. A system comprising:

an interface to a data store, the data store configured to store a set of usage history data associated with a user account operating a workload on a set of virtual machines in a default deployment; and

a hardware processor, configured to communicate with the data store via the interface, the hardware processor configured to:

generate a predictive workload associated with the user account in view of the set of usage history data associated with the user account, wherein the predictive workload reflects an average of a set of resource consumption rates over a first period of time, the set of resource consumption rates determined from the set of usage history data associated with the user account over a set of resources;

responsive to generating the predictive workload, identify a set of available resources in a set of host clouds of virtual machines provided by a cloud provider over the first period of time;

access a set of deployment criteria received from the cloud provider; and

generate a set of subscription parameters in view of the predictive workload, the set of available resources, and the set of deployment criteria to migrate the predictive workload to the set of host clouds of virtual machines.

14. The system of claim **13**, wherein the hardware processor is configured to:

dynamically generate the set of subscription parameters, wherein the set of host clouds comprises a set of geographically dispersed host clouds.

15. The system of claim **14**, wherein the set of geographically dispersed host clouds comprises at least one host cloud operating in a first coordinated universal time (UTC) time zone and a second host cloud operating in a second coordinated universal time (UTC) time zone.

16. The system of claim **15**, wherein the predictive workload is predicted for the user account in the second universal coordinated time (UTC) time zone for a time period for the user account.

17. The system of claim **16**, wherein the time period for the user account is determined by analyzing the set of usage history data of the user account.

18. The system of claim **17**, wherein the set of deployment criteria comprises a least-cost criteria for the user account in view of migration of the predictive workload to the set of host clouds during the time period for the user account.

19. The system of claim **18**, wherein the set of subscription parameters comprises a reduced subscription cost in view of execution of the predictive workload in the set of host clouds during the time period for the user account.

20. The system of claim **19**, wherein the hardware processor is further configured to migrate the workload from the default deployment to the set of host clouds during the time period for the user account in view of the set of subscription parameters.

21. The system of claim **20**, wherein the hardware processor is further configured to migrate the workload from the set of host clouds to the default deployment after the time period for the user account.

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